RYAN

reporter

APRIL/MAY 1966

RYAN
REPORTER
VOLUME 27, NO. 2
PUBLISHED BY RYAN AERONAUTICAL COMPANY
P. O. Box 311/San Diego, California 92112

MANAGING EDITOR/Jack G. Broward
ART DIRECTOR/Al Burgren
PRODUCTION EDITOR/Frances Kohl
CONTRIBUTING EDITORS/George Becker, Jr., Harold Keen
STAFF PHOTOGRAPHER/Dick Stauss
STAFF ARTIST/Matt Giacalone

About the cover: U. S. Army's amazing XV-5A hovers while lifting 235-pound dummy in simulated rescue mission at Edwards Air Force Base.

HAWK

Ryan Firebee awaits retrieval after a Hawk missile exercise on McGregor Range, part of a sprawling 860,000-acre Army complex.

TRAINING: MISSION AT McGREGOR

OVER A CENTURY ago the Army moved into the El Paso, Texas area to set up a garrison. They established the post of El Paso.

Today, more than 100 years later, El Paso and Fort Bliss are the center of Army Air Defense training under the Command of Major General George T. Powers, III, U. S. Army.

An essential part of this vast complex is the McGregor Firing Range.

This 860,000 acre desert facility is the site of intensified Hawk missile battery training of officers and crew members from U. S. Army Air Defense units the world over.

Here rigorous and highly realistic training exercises perfect Army personnel abilities in recognizing and acquiring "enemy" targets with precision and accuracy.

Training at McGregor is climaxed by live firings on actual targets as a final test of training effectiveness.

Operational readiness training of missile crews receives close-in support from a 20-man contractor service team from Ryan Aeronautical Company, San Diego, California. The crew maintains and operates the high performance Firebee jet target drone system at McGregor.

Led by C. D. "Bud" Miller, a veteran Ryan target expert, the team, made up of technicians trained in all phases of Firebee operations, is responsible for flight control, recovery, and rehabilitation of the MQM-34D Firebee targets.

Ryan facilities, located at the northern end of McGregor Range near Orogrande, consist of a well laid out complex of offices and workshops. Electronics, engine, airframe, parachute, and weight and balance facilities are maintained to service the Firebees.

Nearby, 6½ miles from the Ryan headquarters, the launch facilities for the fast-flying drones are located. A zero length, rail launcher, a control blockhouse, a flight hangar and the weight and balance facility are maintained to provide the fast and efficient launch rate needed to support the day-to-day mission requirements of the Hawk missile training program.

Flights of the recently developed Firebee/Towbee target system from this desert facility are proving the feasibility and economy of presenting multiple targets on a single presentation run on the target range.

The Towbee system employs small, wingtip mounted, expendable targets which are deployed once the Firebee is airborne and in position on the range. Wire reels, mounted within the Firebee jet target, pay the Towbees out sequentially to distances up to 5,000 feet, presenting individual passively augmented targets to the Hawk missile batteries on the ground, at speeds up to 520 miles per hour and altitudes from 500 to 50,000 feet.

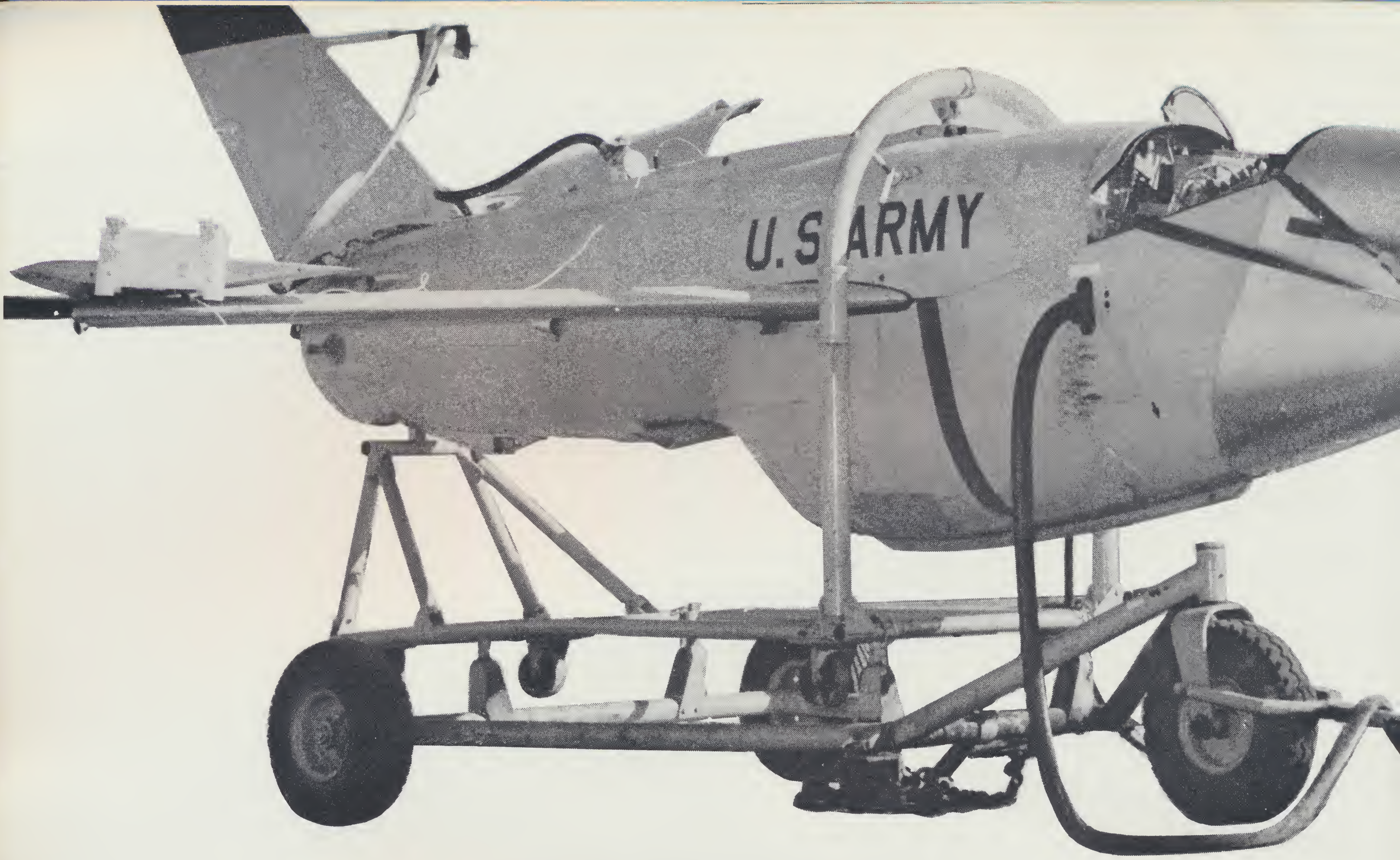
Contractor service support also extends beyond the Air Defense training program at U. S. Army Air Defense Center, to weapons research and development and testing conducted at nearby White Sands Missile

Wingtip mounted Towbees will be towed behind the Firebee in flight.

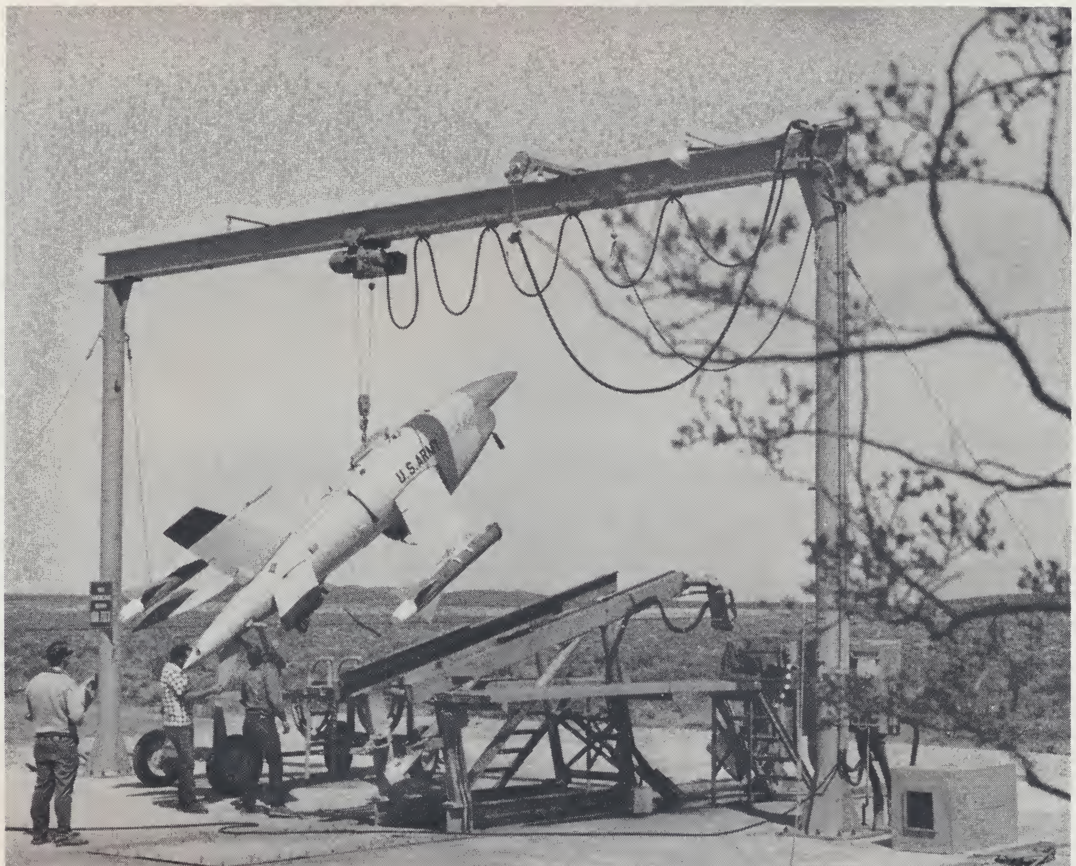
Firebee recovered after mission has been placed on dolly for return to hangar area for recycling after Hawk missile exercise at McGregor.

Ryan Firebee "kill" plaque, displayed by Col. E. W. Schmid, Commanding Officer at McGregor, symbolizes the exceptional skills of Hawk crews.

Pre-launch system check on Firebee-Towbee by J. D. Blankenship, a member of Ryan's 20-man team based at McGregor, adds reliability to Army's Hawk training programs.



Firebee will hurtle from ground launch rail shortly, serving as "enemy" for lethal Hawk missile batteries at Mc-Gregor. Firebee launch team conducts final count-down checking all launch systems.



Engine run-up tests, using portable test unit, boosts reliability of Firebee system during performance. Ryan has based its field team at McGregor Range since 1964.

Range for U. S. Army Missile Command R & D. Firebee jet target flights are launched on request from the Ryan complex in support of the requirement.

The Ryan facility at McGregor is also used to train other Ryan and foreign technicians in Firebee target operations prior to their assignment to similar tasks at worldwide bases.

Recent construction at the McGregor facility has produced a "beefed up" target ground launch system increasing target payload capability by 300 per cent.

Significant enlargement of physical facilities to expedite launches include the addition of a new flight hangar for mission-ready Firebees and a weight and balance building, both located near the launcher and flight control blockhouse.

In recognition of the training program at McGregor, Colonel E. W. Schmid the Commanding Officer, was presented a Ryan Firebee "kill" plaque. Colonel Schmid accepting it said, the plaque was a tribute to the exceptional skill and accuracy demonstrated by the Army Hawk batteries during annual service practice.

—BY CHUCK H. OGILVIE

Hawk missile streaks over McGregor Range during training exercise. Its target is a Ryan jet-powered Firebee.

Remote-controlled flight of Ryan Firebee is traced on plotting board by Joe Mosko, a member of Ryan field team.

With 17 years' experience in building more than 2500 turbojet targets, Ryan Aeronautical Company has been asked by the U. S. Navy to develop a supersonic Firebee.

This growth version, designated the XBQM-34E, is designed to achieve Mach 1.5 (approximately 1,000 mph), retaining the same rugged, reliable performance-proven qualities as its near-sonic ancestors.

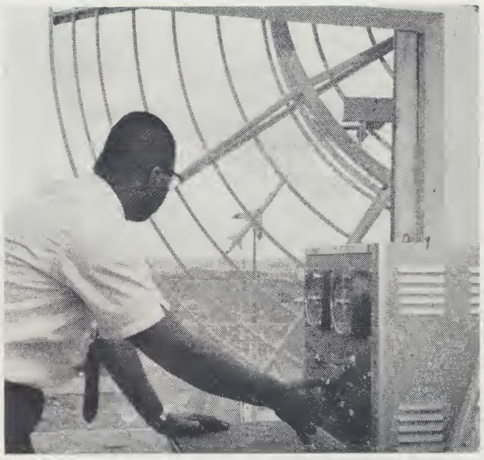
Economy is another inherent quality of the Firebee II, since many of the components of the present day production Firebees will be used in the new model.

Flight tests are scheduled to begin at the Navy Missile Center, Pt. Mugu, California, early in 1967.

SUPERSONIC FIREBEE DESIGN PROGRESS SPEEDED BY ANTENNA TESTS

Full-scale model of Firebee II is mounted on mast (at right) for antenna radiation pattern tests at Ryan Electronic and Space Systems where engineers have created special test facility for Firebee II.

Firebee II engineers M. S. Sevelson (left) and W. R. Karmazin check data obtained at test facility where full-scale Firebee II is undergoing testing.



Radiation pattern is monitored by R. L. Perry during tests of Firebee II's antenna systems.

Varying ranges can be obtained by moving mast on dual tracks.

A FULL SCALE model of the supersonic Ryan Firebee II, now under development for the U. S. Navy, is "flying" atop a 40 foot pole at the Ryan Aeronautical Company's antenna test facility in San Diego, California.

The swept-wing drone aircraft is undergoing antenna pattern testing, a vital step in final design of the target vehicle which will be capable of speeds in excess of 1,000 mph.

The current tests will aid Ryan engineers in the placement, size, and antennas needed for operating the supersonic Firebee II.

A successor to the famed Ryan BQM-34A subsonic Firebee, the new target vehicle is being developed with a minimum of modification requirements for airborne and ground support facilities.

Longer than the BQM-34A (28 feet vs. 23 feet), but with radically swept back, shorter wings (9 feet vs. 13 feet), the slimmer Firebee II, designated XBQM-34E, is a highly streamlined, more efficient target.

New fuel tank arrangements for supplying its Continental YJ69-T-6 engine plus increased thrust capability, contribute to the Firebee II streamlined appearance and supersonic performance.

The XBQM-34E will carry 263 lbs. of fuel within the fuselage, and 400 lbs. in a jettisonable external fuel pod attached beneath the fuselage. With this pod, the XBQM-34E will perform subsonic flight missions with similar performance, endurance and range as the present BQM-34A.

For supersonic flight, the external pod is jettisoned, and using the fuel within the fuselage, the new Firebee will be capable of flying target missions at 1,000 mph at 60,000 feet.

The Firebee II will also be able to fly sea level missions at speeds in excess of 800 mph. Maximum endurance time from launch to recovery sequence for a combined subsonic-supersonic dash mission is estimated at 72 minutes.

Ryan engineers have made allow-

Efficiency of Firebee II antenna system is precision measured at Ryan's test facility.

ances in the design of the supersonic Firebee II for special augmentation equipment and antennas, in addition to the normal command, radar and telemetry equipment.

The antenna testing now in progress at San Diego virtually eliminates the grey areas in antenna design and development. According to M. S. Sevelson, Project Engineer for the Firebee II, "This approach offers an economical means of solving the particular problems of the large number of antennas on the Firebee II. By elimination of scale effects as a variable to be considered in the development phase, and by working with actual antennas at their appropriate frequencies, production antenna characteristics may be predicted accurately. As a result, complete radiation pattern coverages are assured."

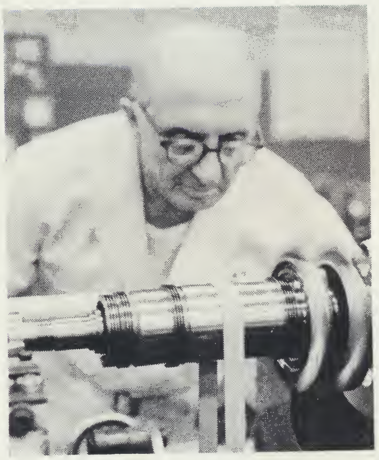
Avionics group leader William R. Karmazin, in charge of the antenna test program for the supersonic Firebee, states. "We realized it would be almost impossible to construct and test with any degree of accuracy, scaled down versions of all the complex antennas required by the XBQM-34E avionics payload. All of the antennas are flush mounted to the surface of the airframe. Most of them have some structural job to do. This is a lot different than the antenna system on the BQM-34A. On that drone, we were able to use scale model techniques with most of the simple UHF/VHF antennas." He added, "The solution for this new drone was to develop this facility to handle a full scale model. This not only allows our antenna development program to move along faster at less cost, but allows us to measure precisely the efficiency of the operational antenna system using actual production antennas."

The new test range is located at the Ryan Electronic and Space Systems plant in San Diego. It is 1,000 feet in length. The tower is 40-feet high and is mounted on rails which give maximum flexibility in establishing test ranges. A feature of the range is the 16-ft. diameter parabolic antenna. This will be used only at the lower frequencies (1,000 mc and below) where it is expected to reduce multipath problems. Smaller antennas will be used for the higher frequencies. A large part of the radio spectrum will be covered by the new range. Work on the supersonic Firebee II alone will involve frequencies extending from 150 mc to 11.0 gc. Use of the range outside these frequencies is restricted only by the availability of test equipment.

Currently, measurements being taken using the full scale model of the XBQM-34E are radiation patterns of the Ryan-designed, flush mounted radar tracking beacon antennas. The next series of tests will provide design verification of antennas for radio control, telemetry, and L-band IFF beacons.

Unique construction of the full scale Firebee II model permits its breakdown into convenient size components. It can be assembled by hand onto the test tower. The model weighs approximately 350 lb. and is 28 ft. in length. Heavier airframes and those not suitable for disassembly can be hoisted into position on the tower by crane. The new test tower can sustain full scale models and operational drones weighing up to one ton.

Development of the new capability has enabled Ryan engineers to make precision pattern measurements under simulated free-space conditions with both the developmental prototypes and production run operational antennas. This has resulted in substantial savings in cost and development time for the supersonic Firebee II program.



Estimated performance of XBQM-34E is verified following altitude chamber tests at Continental. Technician is using a demonstrator engine identical to J69-T-6 aerodynamics to obtain flight data.

Skilled craftsmanship assures quality of Firebee II's new jet engine.

Continental J69-T-6 gives Firebee II added "sting"

Continental engine manufacture blends modern design with human skills for maximum reliability.

THE FIRST test runs of a new jet engine to power the Ryan Firebee II supersonic target now under development for the Navy by Ryan Aeronautical Company are underway at Continental Aviation and Engineering Corporation, Detroit, Michigan.

The current test program is part of an 18-hour endurance qualification plan scheduled for completion this month.

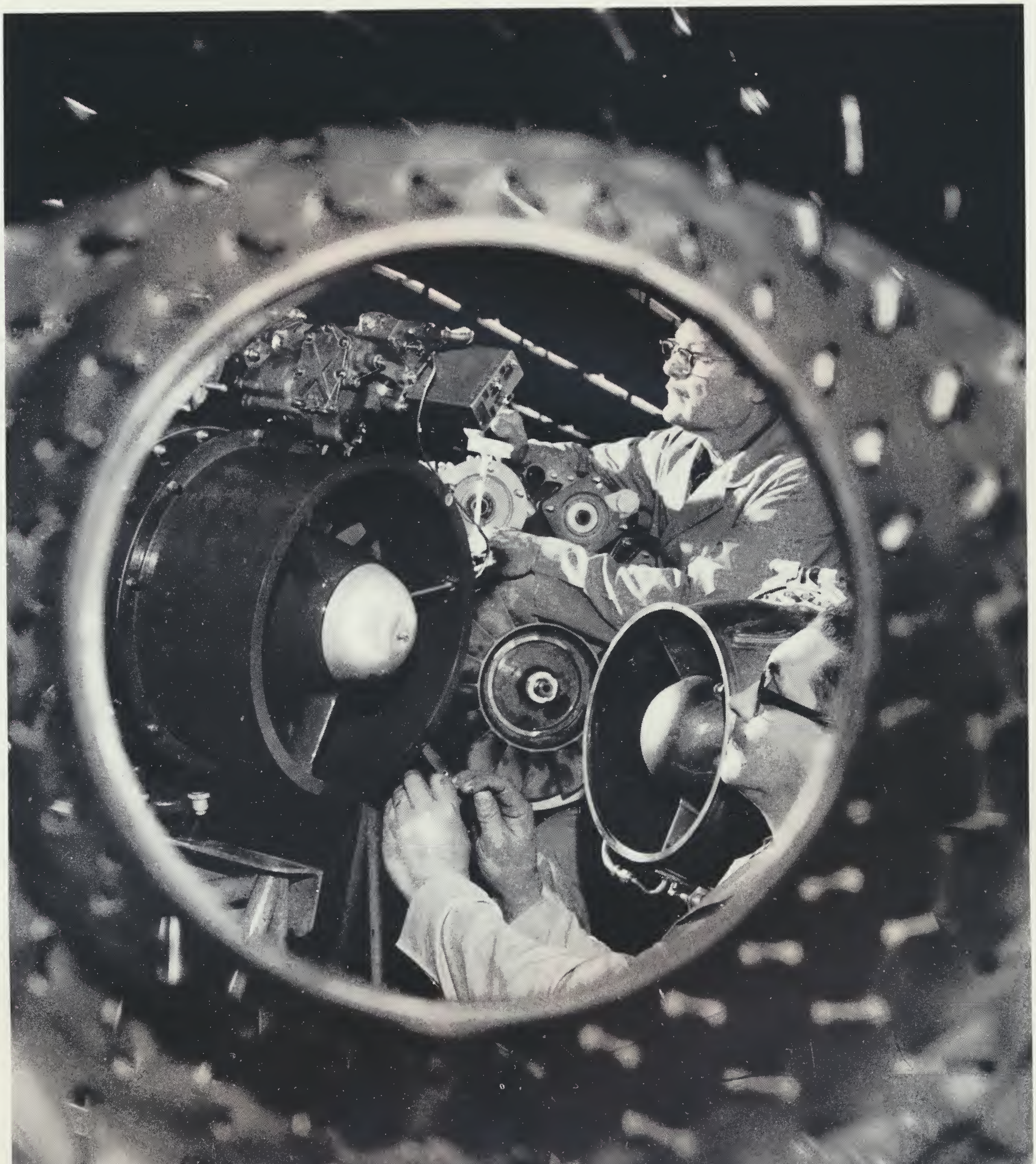
Developing 1840 pounds of thrust, this improved Continental J69 series turbojet power plant will propel the new jet target at speeds up to Mach 1.5 and at altitudes of up to 60,000 feet.

This new growth version of the veteran Firebee target system will provide more realistic simulations of enemy aircraft for training military personnel in air defense systems.

Based on the present Continental J69-T-29 turbojet that has accumulated an enviable record of performance and reliability in the current Firebee, the J69-T-6 incorporates a new transonic axial stage compressor.

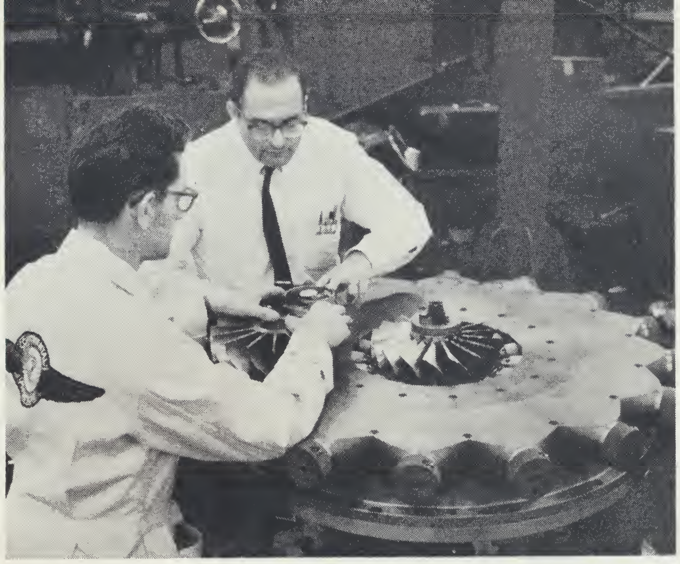
The new development is a result of Continental's continuing program of component improvement on the J69 series of engines. This new compressor made it possible to obtain the additional performance required by the new drone while retaining the basic configuration of the highly successful J69-T-29 engine.

The engine cross-section shows the family resemblance of the J69-T-6 with other J69 engines — the annular inlet, axial



Continental J69 engine combustion chamber frames activity of workers assembling turbine shaft at CAE's Toledo plant. Engine powers Ryan's famous Firebee.

CAE technicians test compressor blades for precise pitch. Growth version J69-T-6 engine compressor is made from titanium.

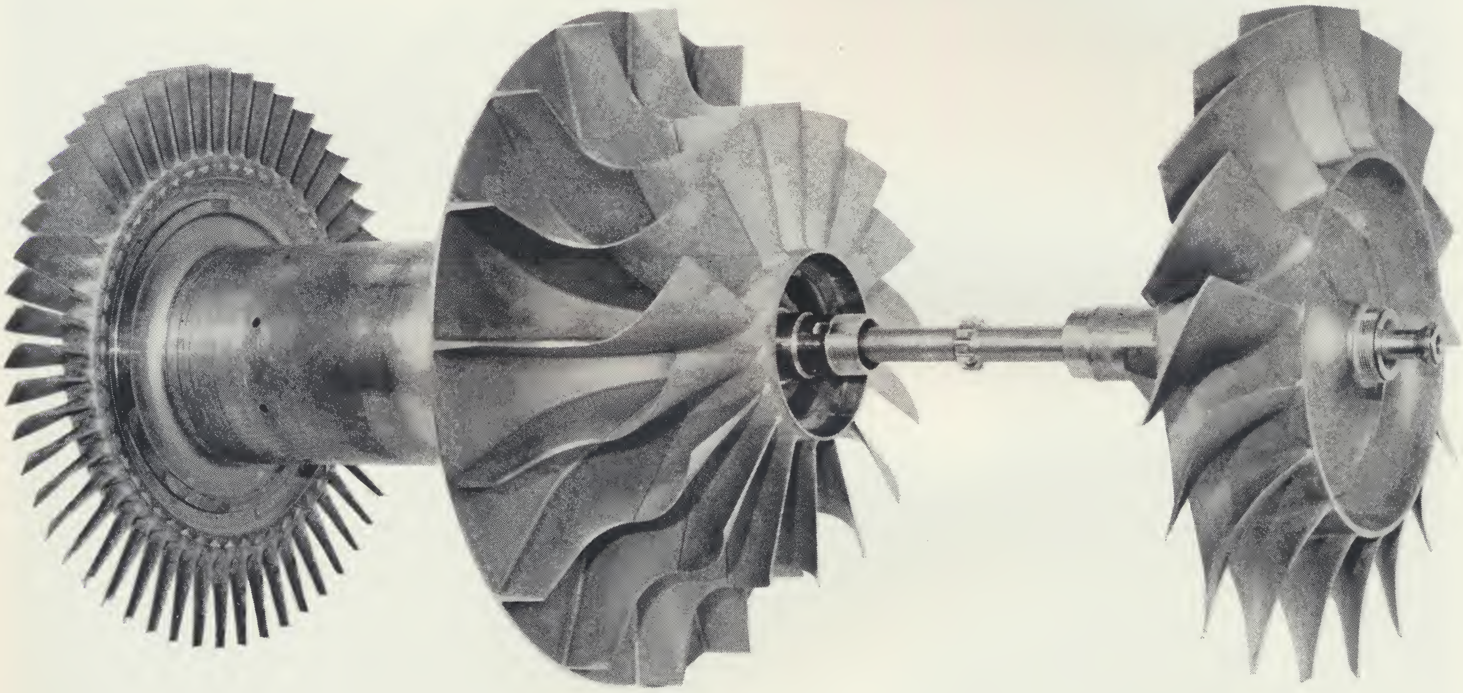


and centrifugal stage compressors, annular combuster, rotary fuel distributor and single-stage turbine.

The new engine design, as with all Continental J69 engines, incorporates simplicity, reliability and minimum weight; the flowpath has a minimum number of parts and the least amount of aerodynamic turning possible to ensure maximum performance.

Modifications to strengthen the engine structure were necessary because of added stresses imposed by requirements for supersonic flight at sea level. These modifications included redesign of the centrifugal compressor cover and radial diffuser and use of titanium for the centrifugal compressor in place of aluminum.

Transonic axial stage compressor, to be used in new Firebee II engine, updates Continental J69 engines.

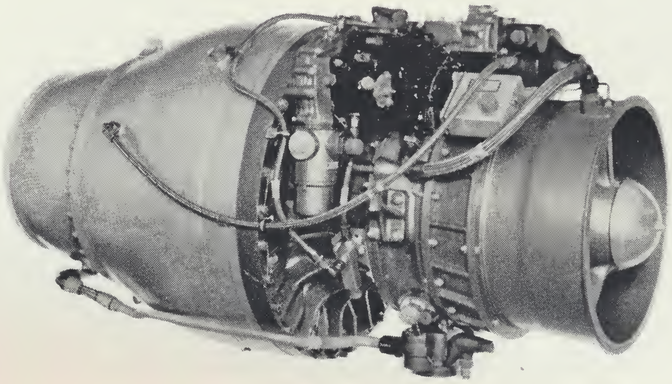


Relocation of accessories, controls and external fittings, including "repackaging" of the fuel control, provides a lower silhouette and reduces engine diameter to fit the slim diameter of the high-performance drone's fuselage.

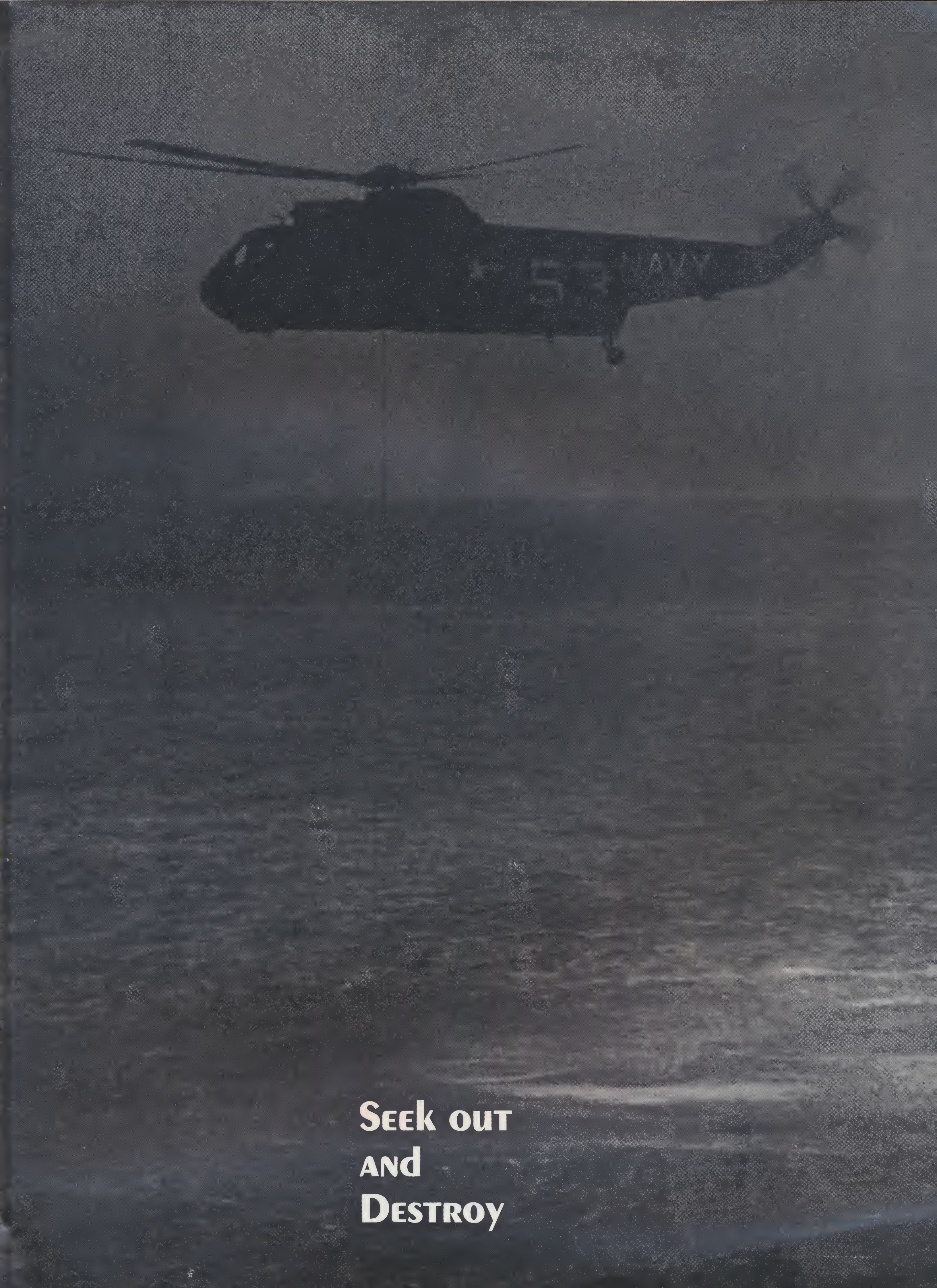
The entire engine program — from inception to qualification, including design and procurement of hardware — spans only three months.

This relatively brief developmental period is attributable, according to program officials to Continental's state-of-the-art advances in transonic axial compressors and fabrication techniques of titanium.

Verification of engine performance estimates throughout the entire XBQM-34E flight regime have been established through the use of a demonstrator engine having an aerodynamic configuration identical to the J69-T-6.



Firebee II's new "sting" will come from this growth version engine, a Continental J69-T-6 jet turbine. Engine will boost XBQM-34E into 1000 mph class.


Seek out
and
Destroy

OFFICERS AND MEN of Anti-Submarine Squadron Six are helping write a new chapter in the history of Naval Aviation today, using elements that characterized the first half-century: Bold courage, dedication and pioneering spirit.

Soon to observe its tenth anniversary of commissioned service, HS-6's logbook chronicles modern-day advances made by the U. S. Navy in anti-submarine warfare.

Already a war-seasoned unit that has five times deployed to Western Pacific areas — twice for service in waters off Vietnam — the squadron will celebrate its tenth birthday this June "on-station" in West Pac.

Under Commander Robert S. Vermilya, HS-6 is one of three squadrons comprising Anti-Submarine Air Group Fifty-Three, whose mission is: "Seek out and destroy enemy submarines."

Herein lies the uniqueness of HS-6's existence and the contributions it is making today to Naval Aviation, indeed to the defense of America.

Based at Ream Field, California, the "Helicopter Capital of the World," during stateside re-training cycles, HS-6 comprises some 50 pilots and 275 enlisted personnel who man and maintain the squadron's 16 SH-3A "Sea King" helicopters.

Fitted with external weapon racks, the helicopters combine detection with "kill" capabilities.

From dusk to dawn and throughout the day, mission requirements range from a gruelling schedule of standard ASW exercise drills on through a spectrum of tactical procedures that challenge the most skilled instrument pilots.

The most rigid disciplines imposed on earth-bound aviation are exercised by rotor-winged pilots as they skim over the crest of waves in the pitch black of night, hover in stationary position and dip the 300-pound transducer beneath the sea.

Anti-submarine helicopters normally operate in the 40-foot zero-air-speed realm. Add the elements of all-weather and zero-zero flight conditions to this "standard" requirement and the personality of HS-6 flight requirements draw into realistic focus.

Under combat operational conditions, Commander Vermilya's unit has the capability for search and rescue missions, as demonstrated in 1964 in the Gulf of Tonkin. The squadron

Space age mission is fulfilled by HS-6 helicopter as Navy Frogman is dropped into sea to aid recovery of manned Mercury space capsule. Unit aided in two Mercury recovery missions.

Ryan's new pre-flight test set, used here by HS-6 technician to check Doppler radar navigation system, is currently undergoing evaluation in the Pacific fleet.

participated in several rescue missions involving downed pilots of carrier based-attack aircraft.

Truly a "space age" organization, HS-6 units have twice been assigned recovery missions related to manned spacecraft. Its first mission came in October 1962 with the recovery of Project Mercury Astronaut Wally Shirra in the mid-Pacific. This was followed in May 1963 with the recovery of a second Mercury Astronaut, Gordon Cooper.

It is a statement of fact, not a boast, when HS-6 pilots assert, "We can fill any mission requirement, anywhere at any time!"

This degree of confidence comes only from men whose professional skills have been demonstrated under actual priority conditions.

Linked to this capability is an inherent characteristic common only with helicopter pilots: precise navigational abilities. As one pilot explains, "There simply isn't any alternative to precise navigation in an ASW unit."

It is in this general area of navigation that Ryan's Doppler radar navigation system (AN/APN-130) is filling

Ream Field spreads out beneath SH-3A following a mission out over the Pacific.

a critically important role today.

This unit is standard equipment in all Navy ASW helicopter units.

Its values are best described by Lieutenant Richard Nichols, who told of operating from the carrier USS Kearsarge on a night mission that took him some 90 miles from the ship.

"I set up my automatic navigation system before takeoff and returned four hours later less than two degrees and a half-mile from the flight deck! Through the use of the Ryan system, I was able to give total concentration to the other mission requirements."

Another HS-6 pilot, Lieutenant Commander James D. Waring, points to the "backup system" that the APN-130 serves during radio failures.

"When it happened to my ship, I simply pushed the memory button and the system re-traced our course back to the ship."

The Ryan Doppler radar navigation system is designed to detect fore and aft motion (heading speed), left and right motion (drift speed) and vertical motion, up and down. This three-way measurement enables pilots to maintain sustained precision hovering under all-weather and zero-zero conditions.

Linked with automatic stabilization and altimetry equipment, pilots can maintain a fully automatic maneuver for normal cruise conditions through transitions in both speed and altitude to a hover.

These capabilities provide a stable platform from which sonar operations can be conducted on a very reliable basis, according to Lieutenant Robert A. Wildman, electronics officer for the squadron.

Extending their support capabilities, Ryan engineers have designed and developed a portable test set for the AN/APN-130 system that is now undergoing evaluation by helicopter units based at Ream Field.

Using this device, one man can perform system checks on helicopters that formerly required three to four technicians.

A production contract that calls for installation of the AN/APN-130 system in HC-1 helicopters, also based at Ream Field, was awarded recently by the Navy.

Thus does the association between Ryan Aeronautical Company and squadrons such as HS-6 become one of prime importance to the continued excellence of Navy ASW helo operations.

Ryan system is flight "insurance" for return trip. Navigator sets system's memory button before the mission.

Workhorses of the ASW fleet come to roost on ramps at Ream Field, "Helicopter Capital of the World." Along with sister squadrons, HS-6 is home based here when not deployed aboard ASW carriers.

Dramatic highlight of environmental test program involved simulated rescue mission. XV-5A descends in hover mode over John Burhans, who raises hands to show freedom of movement. Instrumented dummy is raised by winch.

A VERTIFAN DESIGN . . .

XV-5A: From Concept to Reality

A pause in nearly two years of intense flight testing and pioneering achievement came in late March as the U. S. Army XV-5A V/STOL research aircraft began a four-month rest period for modification at Edwards Air Force Base.

To date in the extended flight test program, the XV-5A has:

Logged nearly 130 hours during 336 flights; demonstrated reliable capabilities of a high-performance jet at speeds of up to 526 miles an hour, blending this characteristic with the vertical-takeoff-and-landing agility of a helicopter; been used to train 15 pilots; concluded a series of VTO hover, takeoff and landing tests over sod, alfalfa fields, unprepared landing sites in the Mojave Desert, over water and loose sand; lifted a 235-pound dummy by winch and cable in simulated rescue operations.

Many of the accomplishments were historical "firsts" no high performance jet aircraft had ever attempted.

The exhaustive flight test program moved the Ryan designed and built XV-5A, incorporating the Vertifan concept, from drawing boards to airborne applications.

Ryan's Chief Engineering Test Pilot, Val E. Schaeffer, piloted XV-5A during tests.

Demonstrating operational capabilities in typical encampment area, XV-5A descends in small area adjacent to tent.

Built for the U. S. Army Aviation Materiel Laboratories (AVLABS), the XV-5A features the General Electric lift fan propulsion system using fans submerged in the wings and nose powered by two dry G.E. J58 turbojet engines.

For V/STOL (Vertical-Short-Take-off-and Landing) flight, diverter valves in the propulsion system divert hot gas from the J85 engines to drive the two, five-foot diameter wing fans and a smaller three-foot pitch control fan located in the nose of the aircraft.

A significant asset of the propulsion system is that no more fuel is used for vertical takeoff, landing and hovering maneuvers, than is used for conventional high speed flight.

Phase I contractor flight tests began in May 1964, and Phase II Army evaluation started in January 1965. The test program conducted at Edwards Air Force Base, included pilot training and austere environmental or erosion tests at the Mojave Desert test site.

Modifications currently being made include the addition of a diverter valve for the pitch fan and mechanical connector that will allow conversion of one jet engine at a time. The pitch fan diverter valve will permit the pilot to shut down the pitch fan during the high speed fan flight approach to conversion, reducing drag effects observed during this flight period.

This modification is expected to increase fan powered speeds from the present 90-100 knots to 110 knots or above. Pitch control at speeds in excess of 70 knots is provided by the horizontal stabilizer and elevator.

A second modification will permit sequential conversion with one engine feeding the fan system through interconnecting ducts while the second engine's thrust is directed out the conventional tail pipes. This change will give the aircraft greater speeds and angles of attack in the fan mode.

A mechanical interconnect between the diverter valves and the horizontal stabilizer will replace an electrical relay system simplifying ground and pre-flight check-out procedures.

A refinement in the mechanical control system of the aircraft will also be made. It will allow the pilot to monitor roll control as he maneuvers the aircraft during vertical take-offs and landings.

A fourth modification will include insulating the cockpit and adding an air inlet forward of the cockpit windshield, to improve the pilot comfort characteristics.

The effect of these modifications will be determined during flight tests scheduled to resume by August.

In the impressive austere environment tests, the XV-5A executed vertical takeoffs and landings from sod, alfalfa fields, plowed dirt, a parachute drop zone, a standard Army T-17 membrane and on the unprepared desert floor.

The exhaustive test program included hovering over water, air-taxiing from the hangar area following standard helicopter procedures. A simulated rescue operation was conducted in which a 235-pound sensored dummy was raised by cable and winch to within four feet of the aircraft, which was hovering at fifty feet altitude.

The erosion tests were conducted to determine the capability of a high downwash vehicle to land on various surfaces. A U. S. Air Force CH-21 helicopter, with a gross weight similar to that of the XV-5A, performed each maneuver at each site prior to the XV-5A as a safety measure.

Conducted for the Army within a

Flying on fans, XV-5A descends in sand cloud during tests in desert (upper right). Circle of visibility beneath plane is caused by its downwash of exhaust. Air taxi test (at right) demonstrates agility of XV-5A in maneuvering thru congested area. Using Army T-17 membrane for a ground cover, XV-5A achieves vertical landing with ease (below). Series of tests included hover-landing investigations over variety of unprepared sites and alfalfa field (below).

period of three weeks at Edwards and the U. S. Naval Ordnance Test Station, China Lake, California, the erosion test program followed a training period in which eight pilots were checked out in the XV-5A, bringing to 15 the number who are currently qualified to fly the aircraft.

All of the erosion test flights were performed by Val Schaeffer, Ryan Chief Engineering Test Pilot and the first man to fly the XV-5A.

Ferried cross-country from Edwards to China Lake, a distance of some 65 miles, the XV-5A completed its initial erosion test over a sod field, hovering and landing on the irregular surface of the field. Erected at the test site were Army tents and materiel simulating a typical encampment. No noticeable disturbance was caused by the XV-5A as it hovered above and landed a scant few yards from the encampment area.

The soil and ground conditions at all sites were evaluated by a team of Army soil experts from Vicksburg, Mississippi Army Experimental Center. The team took samples before and after each test to determine erosion effects.

Despite a full-power turn up on the ground adjacent to the encampment area at China Lake, the only mark left by the XV-5A was a tire impression.

Environmental testing continued on alfalfa fields, on the T-17 membrane, on the raw, unprepared desert floor, in a loose, sandy area in which the earth had been pulverized to a very fine dust to cushion the impact of heavy cargo dropped during cargo parachute tests and a freshly plowed field.

In each instance, the evaluations reflected highly favorable results for the XV-5A in hover, descent and landing modes, over the wide variety of diverse terrain encountered.

Ryan Base Manager at Edwards, John Burhans, simulates air rescue, by standing beneath XV-5A as it descends in hover mode for pickup. Test investigated effects of exhaust velocity on human as plane executes descent in a hover mode.

One test, conducted over a pond with water two to three feet deep, involved hovering operations over two life rafts, one floating free and the other secured to a sea anchor. The free-floating raft was pushed to the edge of the pond by the downwash while the raft with the sea anchor remained within a twenty-foot area beneath the XV-5A.

To evaluate capabilities of the XV-5A to air taxi in congested areas, Schaeffer flew the aircraft in a hover attitude between hangars and rows of parked aircraft, following standard Army helicopter taxi procedures.

The test proved that the XV-5A can operate within confined areas without any hazard to nearby aircraft, personnel or equipment and that the fan downwash, even in a confined area, does not present any re-ingestion problems.

Temperature-sensing paint on the helmet and shoulders of the dummy indicated that there were no effects from the heat and downwash from the aircraft. Shaeffer translated the aircraft at speeds up to 30 mph with no noticeable strain on the dummy.

In a related test, the aircraft descended in hover mode to 40 feet above a man standing at a "pickup" point. The man stated during his debriefing that, "Wind blast and noise were not objectionable. It would have been possible for me to climb into a rescue seat or sling without difficulty."

The U. S. Army is now studying results of these tests and will use the data in the design of advanced V/STOL aircraft.

Compared to a UH-1B helicopter in a series of agility tests, the XV-5A was flown over a closed course by Schaeffer in fan mode or hover configuration, matching the maneuvers of the helicopter.

Schaeffer, in the XV-5A, completed the course in five and one-half minutes, then he immediately flew the helicopter over the course in three minutes, 50 seconds.

Maximum climb rates at 2200 feet per minute were recorded in vertical takeoff and fan powered descents to vertical landings were demonstrated at a comfortable descent rate of 2500 feet per minute.

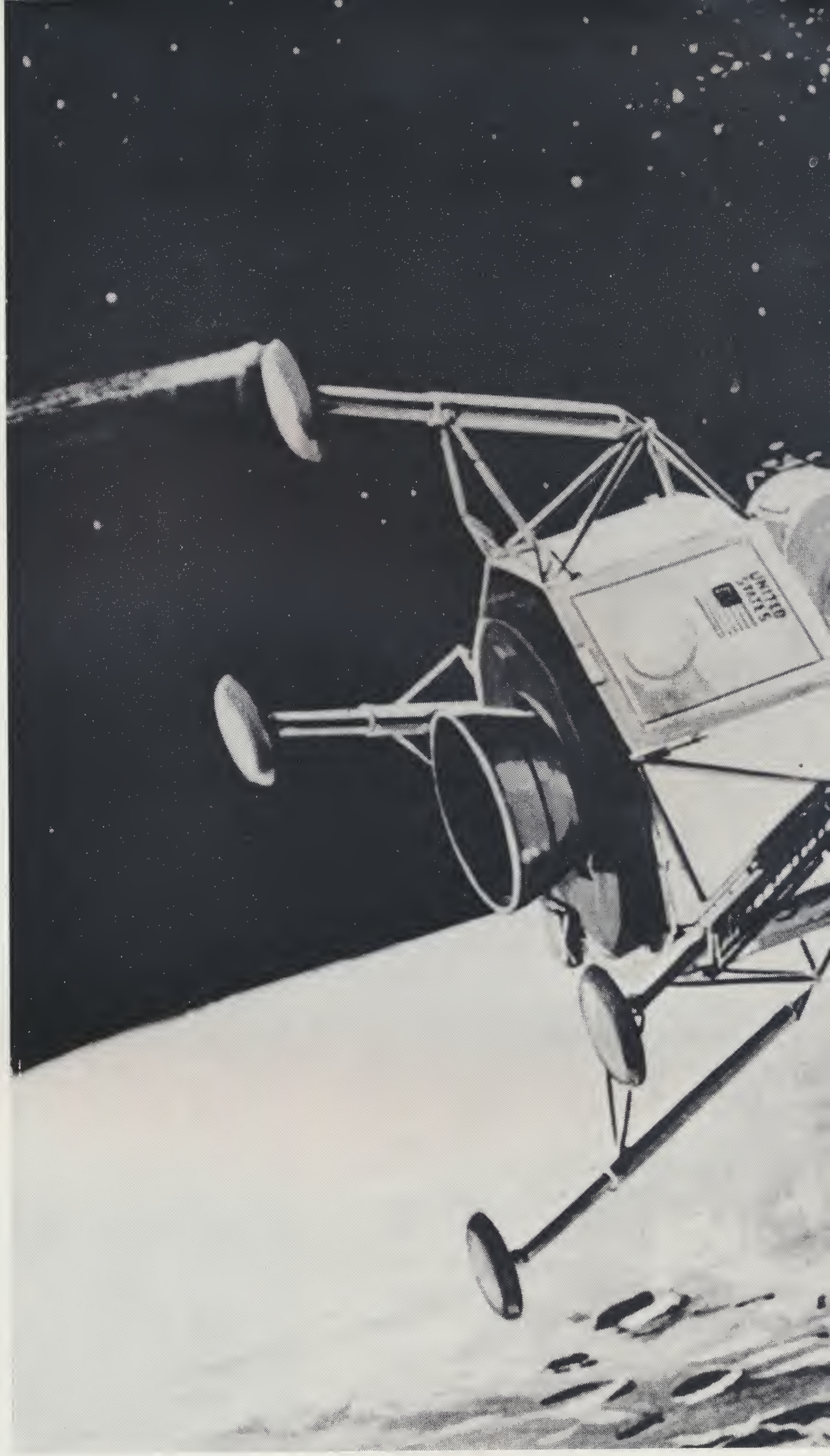
Variable performance takeoffs were accomplished to arrive at a pre-selected point, such as 2500 feet and 200 knots. In conventional jet takeoff, it took one and one-half minutes to attain pre-selected altitude and speed.

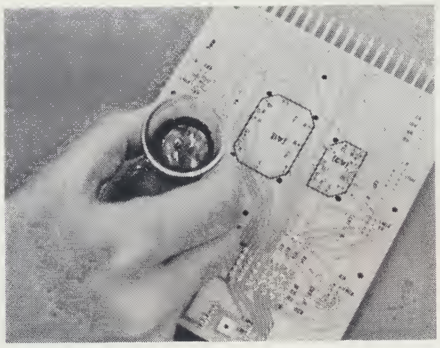
In the XV-5A, Schaeffer arrived at the designated point in slightly over two minutes, using vertical takeoffs, maximum translation to conversion, then conventional jet flight.

The XV-5A hovered continuously in one test for 15 minutes to determine effects on the fan system for sustained operations. No noticeable effects were recorded during this test.

The XV-5A flew sideways at speeds up to 30 miles per hour and backwards at 23 miles per hour in agility tests.

Now enjoying the first "pause" in the exacting test program, the XV-5A has achieved a growing reputation as the "most advanced high performance jet V/STOL aircraft flying today."





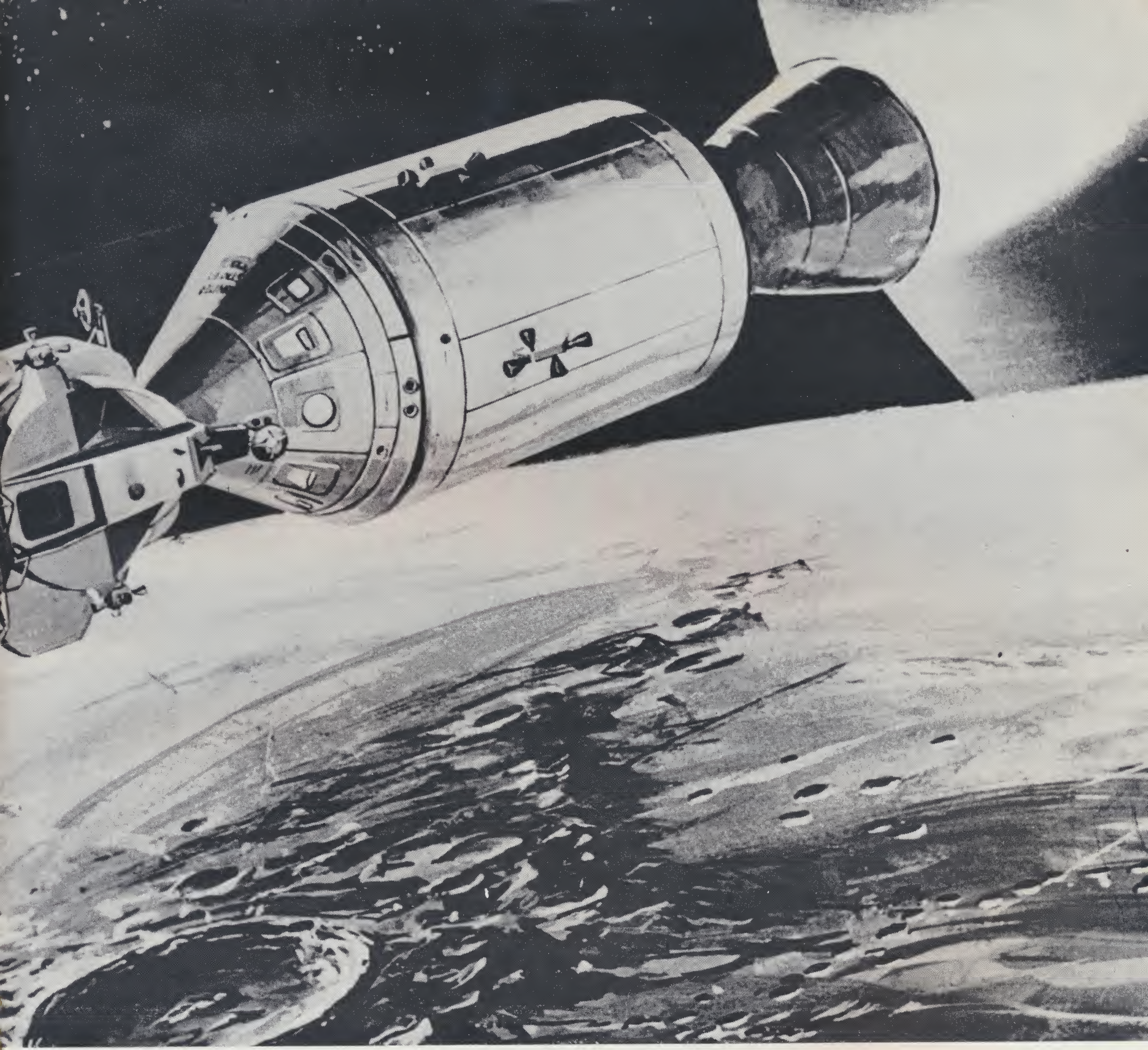
Micro-miniaturized, integrated circuitry reduces size and weight of components.

RCA, RYAN POINT THE WAY WITH LEM RADAR SYSTEMS

By *MICHAEL G. O'CONNOR*
Manager, RCA Liaison Office
Radio Corporation of America

THE current Gemini flights and the preparations for the Apollo Lunar Expedition during this decade are clearly predictive of the future requirements for spacecraft navigational and maneuvering sensors. Indicated is a need for sensors that will be capable both of independent operation and cooperation with other spacecraft and which can function without assistance from Earth tracking stations.

Until now, spacecraft have been Earth-orbiting satellites, bound by the Earth's gravity and dependent in space centers and tracking stations on the ground.



Lunar Excursion Module will still be docked with Command-Service Modules as Apollo spacecraft enters Lunar orbit.

Landing on the Moon, however, requires both altitude and velocity of approach measurements, which should be obtained directly from the lunar surface to improve confidence. Similarly, at the time when the returning Lunar Excursion Module (LEM) docks with the waiting Apollo Command Module, the precise maneuvers required to establish a successful safe-closing trajectory make directly measured range and range rate highly desirable. This closing maneuver demands a sensor of precision beyond the requirements of one which can accomplish the mid-course maneuver.

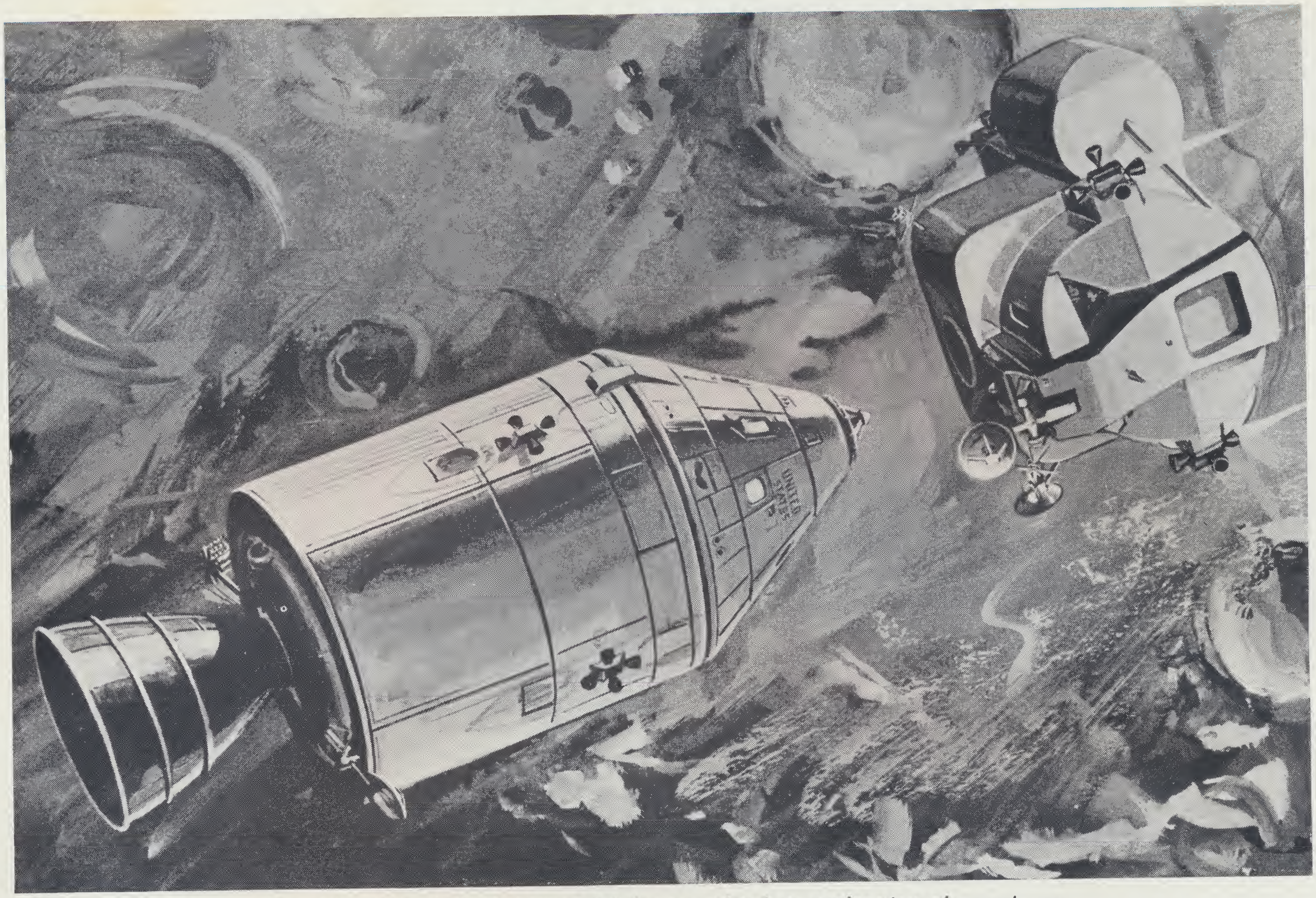
This description of the LEM radars illustrates the future role of spacecraft sensors. Interplanetary space guidance will continue to be largely done by the Manned Space Flight Network (MSFN) and spacecraft inertial/optical systems in the foreseeable future.

But for close-in, short range approaches to planets and for relatively short range guidance of two or more spacecraft maneuvering cooperatively, the radar sensor appears highly desirable.

It may well be necessary to accomplish a landing or rendezvous without communication with Earth. The spacecraft may encounter environmental interference in planetary landing. Or the flying spacecraft may find itself in a disadvantageous astronomical position relative to planets or space phenomena.

These situations may also impose the need for direct measurements because of astronaut reluctance to rely exclusively on automatic control in critical situations.

A third consideration, that of "real time," arises as spacecraft operate farther and farther into space. Although the delays due to data transmission time and reaction of man/machine combination can be compensated for



Manned LEM vehicle (upper right) has completed its exploration of moon's surface and now maneuvers in lunar orbit for docking with Command Service Module.

and applied within command and control subsystems, the appreciable increase in transmission time to remote control stations on Earth as spacecraft probe deeper into outer space makes Earth-based control of landing and rendezvous impossible.

Therefore, spacecraft of the future should contain their own radar sensors for planetary landings and space rendezvous. However, the characteristics of the required sensors pose some problems.

A single multi-purpose radar sensor capable of range and angle resolution at long ranges and precision at short ranges is, of course, the desirable goal. But it is also necessary to simultaneously achieve accuracy and reliability, while restricting the power consumption and the weight of the sensor to compatibility with the spacecraft itself.

Fortunately, our space technology has advanced to the point where available mission equipments are capable of being transported by the spacecraft presently contemplated.

The Rendezvous Radar and the Landing Radar now being developed by RCA and Ryan under RCA subcontract to Grumman Aircraft Engineering Corporation are examples of presently available sensors.

However, as with all operating equipment, these radars must not only meet standards of performance but also must satisfy an evaluation of their contribution to mission success in comparison with the requisites of their installation and support. This imposes the need for reducing volume, weight and power requirements in the development of present equipment. Future systems may require new and perhaps radical designs to make these systems even more compact.

This requirement for minimizing operating equipment to the irreducible essential has led to a broader basis of participation in overall goals by the industrial and scientific organizations involved in the design, development or manufacture of spacecraft hardware or subsystems. The rapidly advancing and changing parameters which, now and for the near future, will govern the functional performance of various vehicles in space will best be met by a responsible cooperative approach to common utilization or common problems. Systems of varying manufacture will be required to operate in conjunction with one another and at times, for and in lieu of each other. This interchange involves greater insight by subcontractors and more constructive review by succeeding contractors or consultants than in the past.

This philosophy of cooperation has been demonstrated in the development of the two radar sensors for the Grumman-built Apollo LEM. The Rendezvous Radar (RCA) and the Landing Radar (Ryan under subcontract to RCA), are independent developments for separate purposes, yet both have utilized a common approach to the problems of weight and power.

To minimize weight, a new method of either reducing or consolidating the parts count of subassemblies was required. This led to investigation of the integrated circuit. Developed was a new solid state device capable of re-

Ryan-RCA interchange of technical knowledge and cooperation is an important element in the design-development of LEM systems.

placing from 10 to 15 discrete parts, but which was micro-miniaturized to less than 1/300th of one cubic inch in volume.

The reliability and low cost, as well as the light weight of the integrated circuit, was very attractive. But it was also necessary to devise a means of minimizing the high density wiring that would be involved in coupling the integrated circuit chip to connections or other circuits. The solution was the use of the printed wiring circuit which had proven successful with cordwood modules.

Similarly, the desire to maximize reliability prompted selection of a solid state, frequency multiplier chain microwave energy source for the Landing Radar as well as for the Rendezvous Radar. The RCA Electronic Components and Devices Division had such a device which could be developed for the particular service by the time required for the RCA/RYAN subcontract; design, therefore, had to be based on expected performance.

Ryan and RCA accepted the future use of the device and incorporated the RCA-designed multiplier chain in an experimental model of the Landing Radar and Rendezvous Radar. This model is now operating under test at the Grumman Aircraft plant at Bethpage, Long Island.

The research, experimentation and engineering effort that resulted in these two accomplishments deserves greater presentation than is given in this article. It must be said, however, that only through this interchange of technical knowledge and cooperation can the stringent requirements of the overall LEM system be satisfied, and the beginning for spacecraft sensors inaugurated.

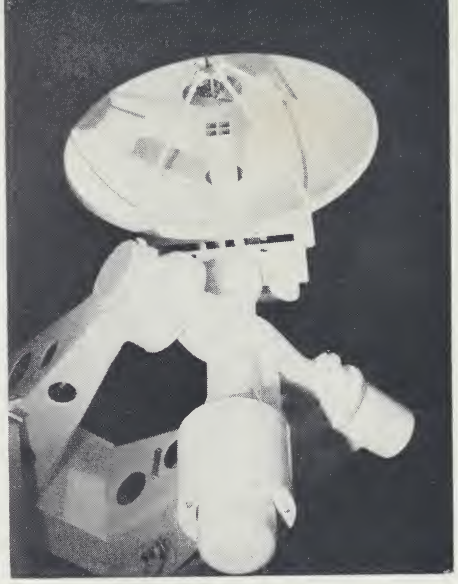
This is not to say that the job is complete; indeed, it has only begun. The ability of the new components to withstand the shock and vibration of rocket operation has yet to be proved. Difficulties of electronic interference and thermal dissipation in the high density packaging of the final flight configurations are being anticipated.

But performance has been demonstrated. The forthcoming models of both radars can now proceed through the continuing improvement of test and integration to their ultimate configuration for the Apollo mission.

Likewise, the ultimate utilizations of the Landing and Rendezvous Radar sensors are not yet fixed. Conceived originally for the specific purposes of controlling LEM descent to the lunar surface and LEM trajectory to rendezvous, these sensors — either in combination or supplementation—can provide additional safeguards to the accomplishment of the Apollo mission. One such use is to crosscheck the guidance systems or direct display of measurements for manual rendezvous in event of primary system failure. A second use is the cooperation of the sensors with a lunar marker or beacon to improve landing accuracy.

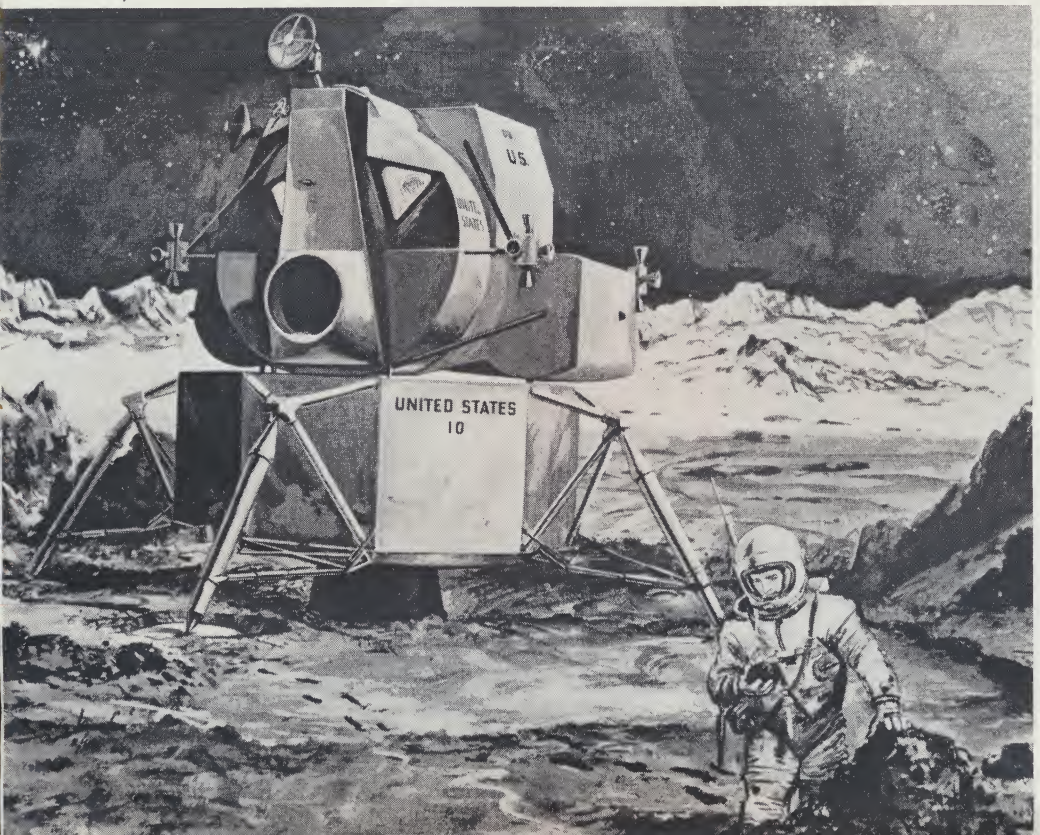
These uses are not only available, but are also indicative of the possibilities of future sensor functions. Such functions can be exploited for specific missions or developed to cooperate with other control or guidance subsystems to reduce hardware or improve capability.

In summary, it is evident that spacecraft of the future will need their own short range sensors for guidance and control. The selection of radars for the LEM/Apollo mission was based on the reliability and flexibility of this form of sensor as well as the experience with these sensors in aircraft and satellites. Although they have advanced the state of the art, the LEM radars are but a beginning. The future of the radar sensor in space is yet to be realized. The task ahead will require maximum effort and cooperation in the fields of science and industry. The challenges of the future must not be constrained by the accomplishments nor the disappointments of the past. Rather, they must be analyzed as they arise and must be answered with the combined forces of imagination and skill.



RCA Rendezvous radar assembly provides communications between LEM and CSM.

One of two astronauts aboard Lunar Excursion Module gathers samples of Lunar surface. One astronaut is in the LEM vehicle while a third is orbiting Moon in CSM.



VOYAGE OF THE "8351"

HOWLS OF glee went up aboard the cruiser USS Columbus as the order was barked out, "Cease Fire!" The ship's sharpshooting gunners scored what appeared to be a brilliant "kill" against a Ryan Firebee.

The time was March 30, 1964, and the Columbus' firing exercise—held off the coast of San Clemente Island—followed exercises in which the USS Constitution aircraft had fired air-to-air missiles at the jet-powered target.

Stricken from the Navy's inventory after awarding a "kill" to the Columbus, the episode of the Firebee "8351" could have ended that Spring day like countless others held throughout the world.

More than two years later, however, and some 3,600 nautical miles from San Clemente Island, Firebee "8351" has been recovered by the USS Talladega, bobbing in reckless abandon across the broad expanse of the Pacific!

Authorities piecing the saga of the wayward Firebee together, speculate that a Columbus missile's near-miss may have caused a flameout which could have gone undetected by controllers.

This action would have been counted as an actual "kill," since the system's automatic recovery device was activated. Descending slowly by parachute over the horizon and out of sight, Firebee "8351" was never seen again until April 5, 1966.

Ensign Hugh L. Webb, officer-of-the-deck aboard the attack cargo ship, USS Talladega, was the first to spot the bright orange object, floating some 6,000 yards from the ship's position.

En route from Western Pacific areas, the ship was 1700 miles southwest of the Hawaiian Islands bound for Long Beach.

Captain John F. Davis ordered his ship into position for a mid-ocean pick-up, put a small boat crew into the water and, within 45 minutes, was back on speed and course on his homeward bound voyage.

Examined by Ryan Field Service technicians at Barber's Point, Hawaii where the "8351" had been turned over to Composite Squadron Five, officials said the self-contained electronic systems were in "remarkably good condition.

"After decontamination and installation of electronic components, I wouldn't be at all surprised if '8351' could be flown again," reported Ryan Base Manager Bill J. Sved in Hawaii.

How the Firebee reached its rendezvous point with the Talladega will never be known for certain, but officials say it could have drifted South and West from its splashdown point. The speed of currents in this area averages between 8 and 12 knots per day.

Based on this information, it is possible that No. 8351 drifted some 3,000 to 5,000 miles during its epic voyage!

Rugged design and construction techniques of the Ryan Firebee, which include flotation devices and watertight sealed equipment compartments, are responsible for "8351's" amazing durability.

Officials say that its 25-month voyage is the record for Ryan Firebee distance-floating.

One Firebee was recovered 13 months after splashdown in the Pacific and others have been periodically retrieved after varying periods of time in the oceans of the world.

The Venezuelan destroyer Almirante Brion spotted a Firebee drifting in the Atlantic some six months after it had been launched by the NAS Roosevelt Roads facility in Puerto Rico.

More than 200 miles off the coast of Southern California, the motor tanker St. Matthew, sailing under Panamanian registry, recovered a Firebee BQM-34A while en route to Tacoma, Washington.

The retrieved Firebee was turned over to the Navy authorities at Tacoma for return to Point Mugu where a Ryan field service crew is assigned.

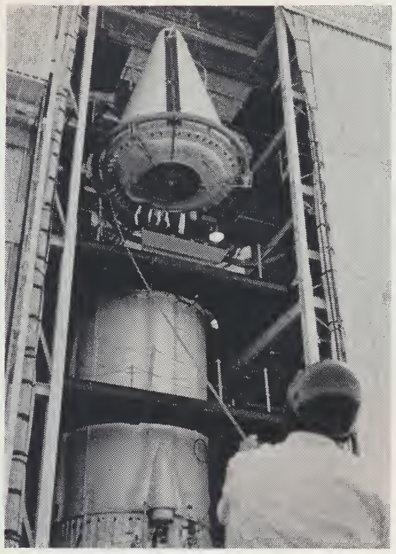
Still other Firebees have been recovered in the North Atlantic and even in waters off Norway! In most instances, records indicate that the Ryan Firebees were rehabilitated for operational use after recovery.

Candid photos taken by a USS Talladega crewman document mid-Pacific recovery of truant Firebee "8351," missing from U. S. Navy's inventory since March 30, 1964.

In its 17th year of design-production of Firebee targets, Ryan Aeronautical Company has provided more than 2500 of the remarkable, remote-controlled units to the Army, Navy and Air Force.

Used as a primary vehicle for weapons training exercises and weapons systems research, development and evaluation, Firebees have acquired worldwide acclaim as one of the most effective airborne systems in existence in fulfillment of mission objectives.

Ryan Systems Back Surveyor, Apollo Programs



Surveyor vehicle, encased in nose-cone, is "mated" to an Atlas-Centaur launch vehicle in San Diego test.

RYAN Aeronautical Company delivered two key systems during the first quarter of 1966 that are designed for use in Surveyor and Apollo spacecraft in un-manned and manned soft-landings on the moon.

The fourth flight assured model AM-4 of Surveyor's radar altimeter and Doppler velocity sensor (RADVS) system was delivered to Hughes Aircraft Company, February 11, six days ahead of schedule. AM-4 is to be used as a spare system for the initial Surveyor launches scheduled for this year.

Under direction of the National Aeronautics and Space Administration, the Jet Propulsion Laboratory at California Institute of Technology is Surveyor program manager with Hughes Aircraft assigned the responsibility for spacecraft design, construction, check-out, and integration with the launch vehicle.

Under existing contract agreements to Hughes, Ryan will build ten RADVS systems for use in soft-landing Surveyor spacecraft on the moon.

Similar in function to the Surveyor system, but more exacting, is the landing radar system Ryan is building for use by the Lunar Excursion Module which will soft-land Apollo astronauts on the moon.

The first flight configured system, now undergoing integration tests, was delivered to Radio Corporation of America on February 4. Under contract to Grumman Aircraft Corporation, RCA is responsible for the Apollo systems.

One of the major functions of both the Surveyor and LEM RADVS systems will be to measure the spacecraft's distance from the lunar surface and guide the retrorocket actions that contribute to the actual soft-landing.

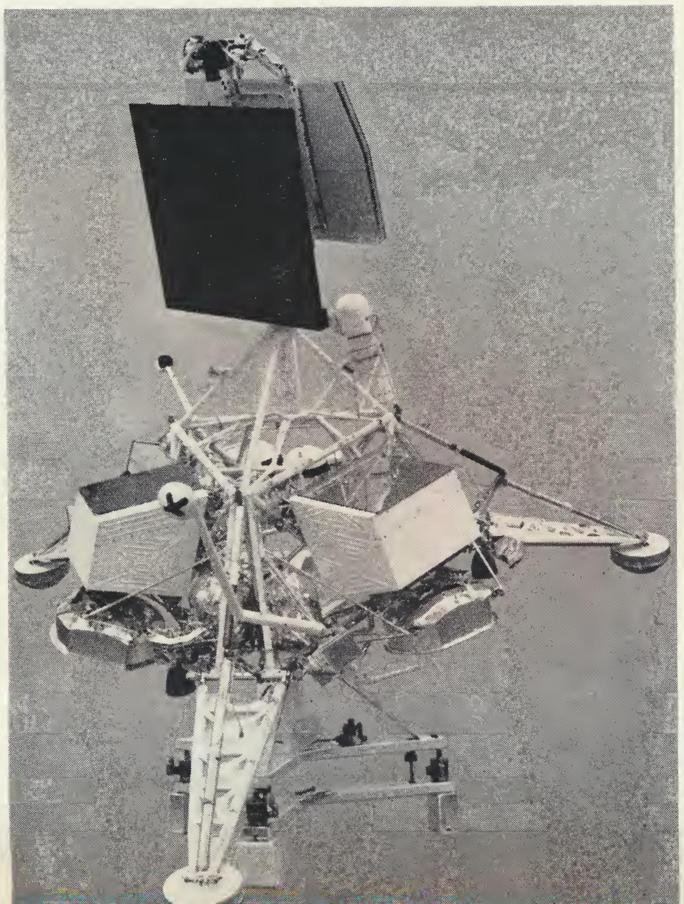
Through use of the Doppler velocity sensor function incorporated in the RADVS system, the Surveyor spacecraft's descent attitude to the lunar surface will be maintained within tolerable limitations.

Current schedules published by Aviation Week and Space Technology for Surveyor launches indicate that SC-1 will be launched in late May or early June; SC-2 in the third quarter of 1966; and the balance of the seven engineering models to be launched in 1967.

The Surveyor spacecraft will be boosted into orbit by Atlas-Centaur launch vehicles.

Surveyor's system is assembled and tested at Ryan under stringent "clean room" standards, adding reliability to system's function.

Ryan's high-priority cargo, the Lunar Excursion Module landing radar system, was escorted cross-country by Ryan's Paul Melton.



RADVS antennas (lower left and right sides) will be "looking down" on moon as vehicle makes its soft-landing.